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(54) **METHODS, SYSTEMS AND APPARATUS TO REDUCE PROCESSOR DEMANDS DURING ENCRYPTION**

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H04L 9/06	(2006.01)
G06F 9/00	(2006.01)
G06F 21/00	(2013.01)

(52) **U.S. Cl.**

CPC ***H04L 9/0637*** (2013.01); ***G06F 9/00*** (2013.01); ***G06F 21/00*** (2013.01); *H04L 2209/12* (2013.01)

(58) **Field of Classification Search**

CPC H04L 9/0637

See application file for complete search history.

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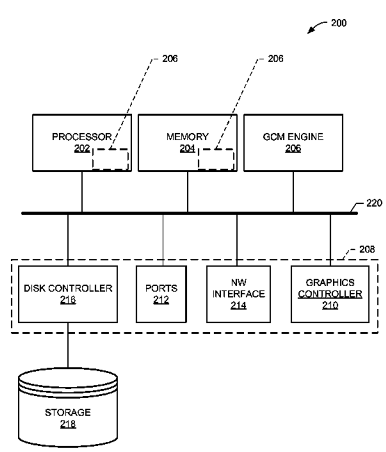
(57) **ABSTRACT**

Methods and apparatus are disclosed to reduce processor demands during encryption. A disclosed example method includes detecting a request for the processor to execute an encryption cipher determining whether the encryption cipher is associated with a byte reflection operation, preventing the byte reflection operation when a buffer associated with the encryption cipher will not cause a carryover condition, and incrementing the buffer via a shift operation before executing the encryption cipher.

25 Claims, 7 Drawing Sheets



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100

106

102

```
CTR = byte_reflect(CTR)
xmm0 = CTR+1
xmm1 = byte_reflect(xmm0)
xmm1 = AES(xmm1,Key)
xmm1 = xmm1 XOR plaintext
```

108

104

110

FIG. 1

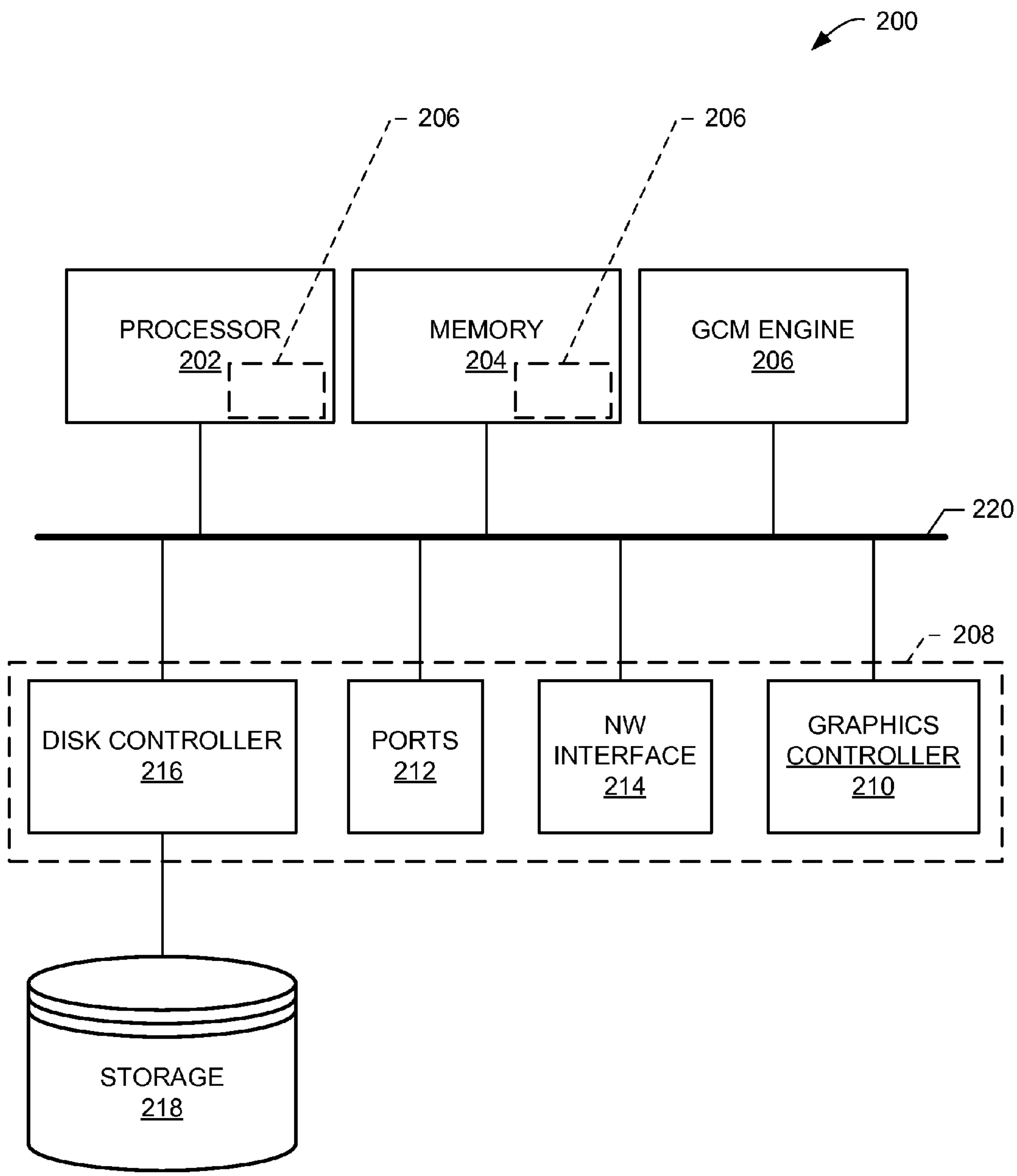
200
206
206
PROCESSOR
202
MEMORY
204
GCM ENGINE
206
220
208
DISK CONTROLLER
216
PORTS
212
NW
INTERFACE
214
GRAPHICS
CONTROLLER
210
STORAGE
218

FIG. 2

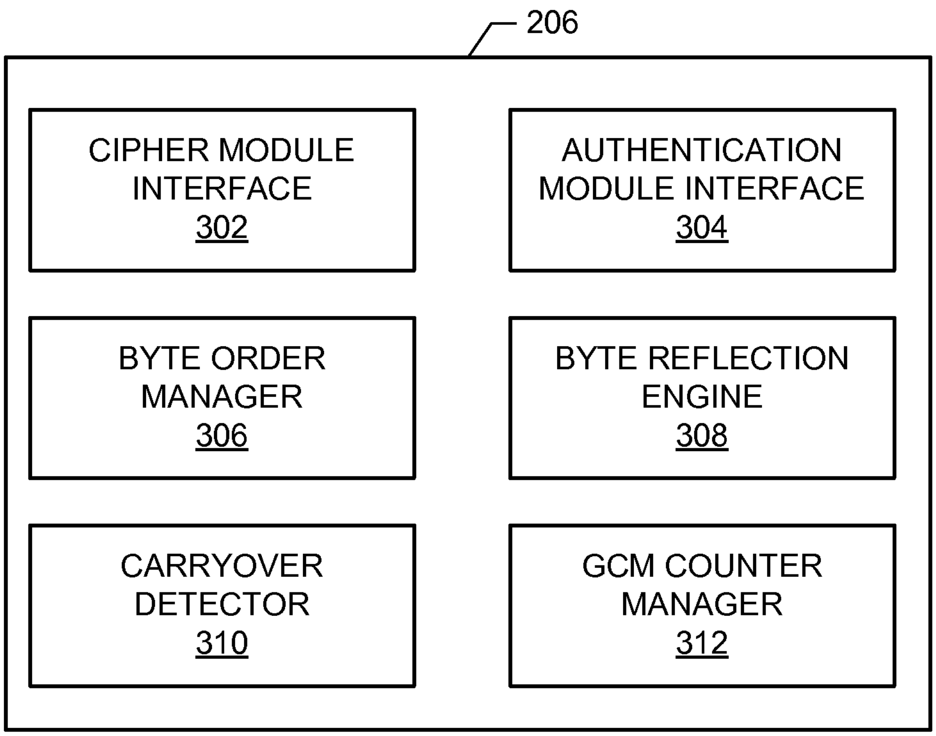
206
CIPHER MODULE INTERFACE
302
AUTHENTICATION MODULE INTERFACE
304
BYTE ORDER MANAGER
306
BYTE REFLECTION ENGINE
308
CARRYOVER DETECTOR
310
GCM COUNTER MANAGER
312

FIG. 3

```
UINT8 index = msb (CTR)                          402
for (i = 0; i < buffer_size < i++)               404
{
        if (index == 0xFF)                       406
418 {       CTR = byte_reflect(CTR)
            CTR = CTR+1
            CTR = byte_reflect(CTR)
            xmm1 = AES (CTR, Key)
            xmm1 = xmm1 XOR plaintext
            index = 0

        else
408 {       CTR = CTR + 1 (1<<(128-8))           410
            xmm1 = AES(CTR,Key)                  412
            xmm1 = xmm1 XOR plaintext            414
            index = (index + 1) mod 0x100        416

}
```

FIG. 4

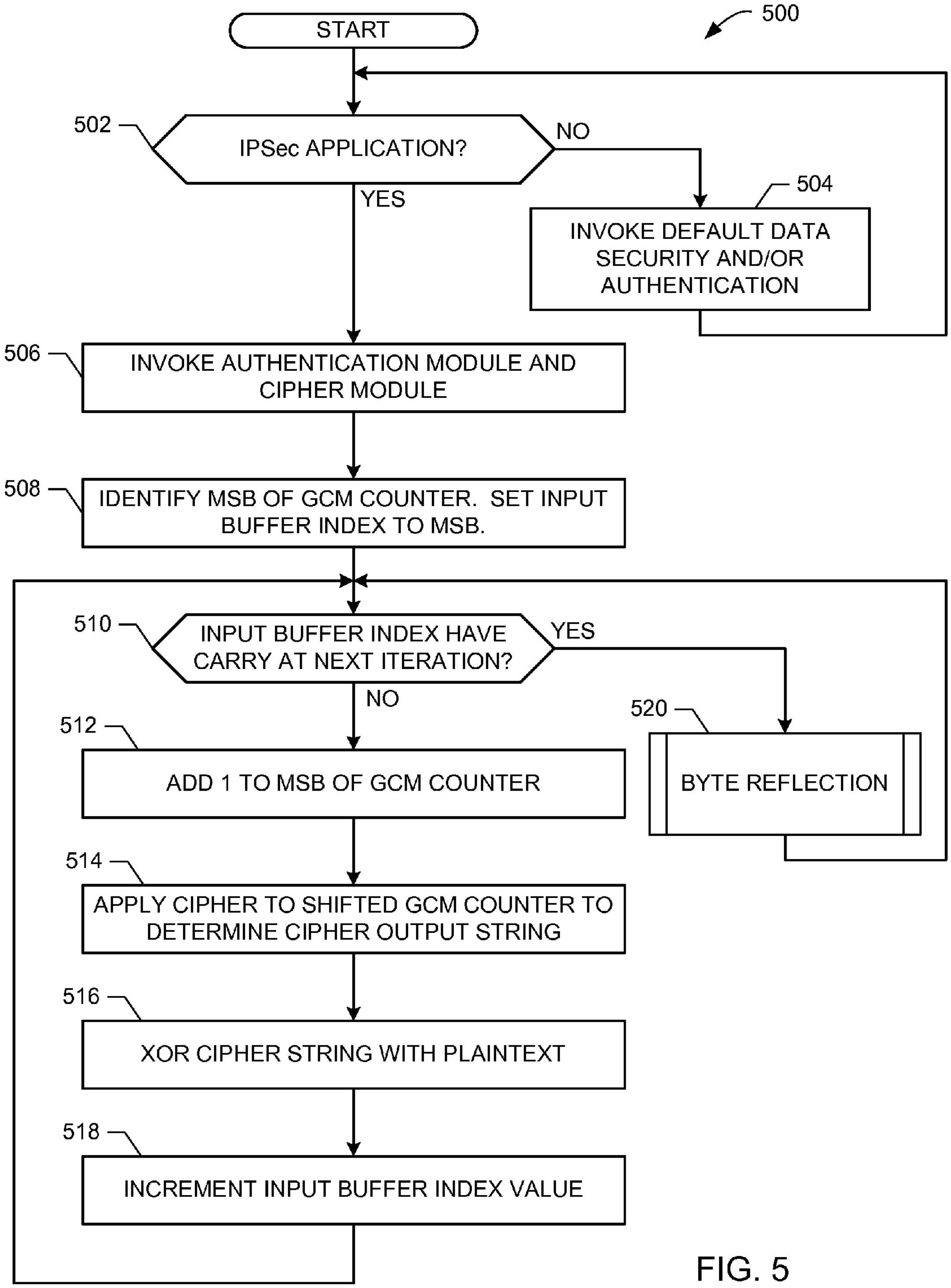
500
START
502
IPSec APPLICATION?
NO
YES
504
INVOKE DEFAULT DATA SECURITY AND/OR AUTHENTICATION
506
INVOKE AUTHENTICATION MODULE AND CIPHER MODULE
508
IDENTIFY MSB OF GCM COUNTER. SET INPUT BUFFER INDEX TO MSB.
510
INPUT BUFFER INDEX HAVE CARRY AT NEXT ITERATION?
YES
NO
520
BYTE REFLECTION
512
ADD 1 TO MSB OF GCM COUNTER
514
APPLY CIPHER TO SHIFTED GCM COUNTER TO DETERMINE CIPHER OUTPUT STRING
516
XOR CIPHER STRING WITH PLAINTEXT
518
INCREMENT INPUT BUFFER INDEX VALUE

FIG. 5

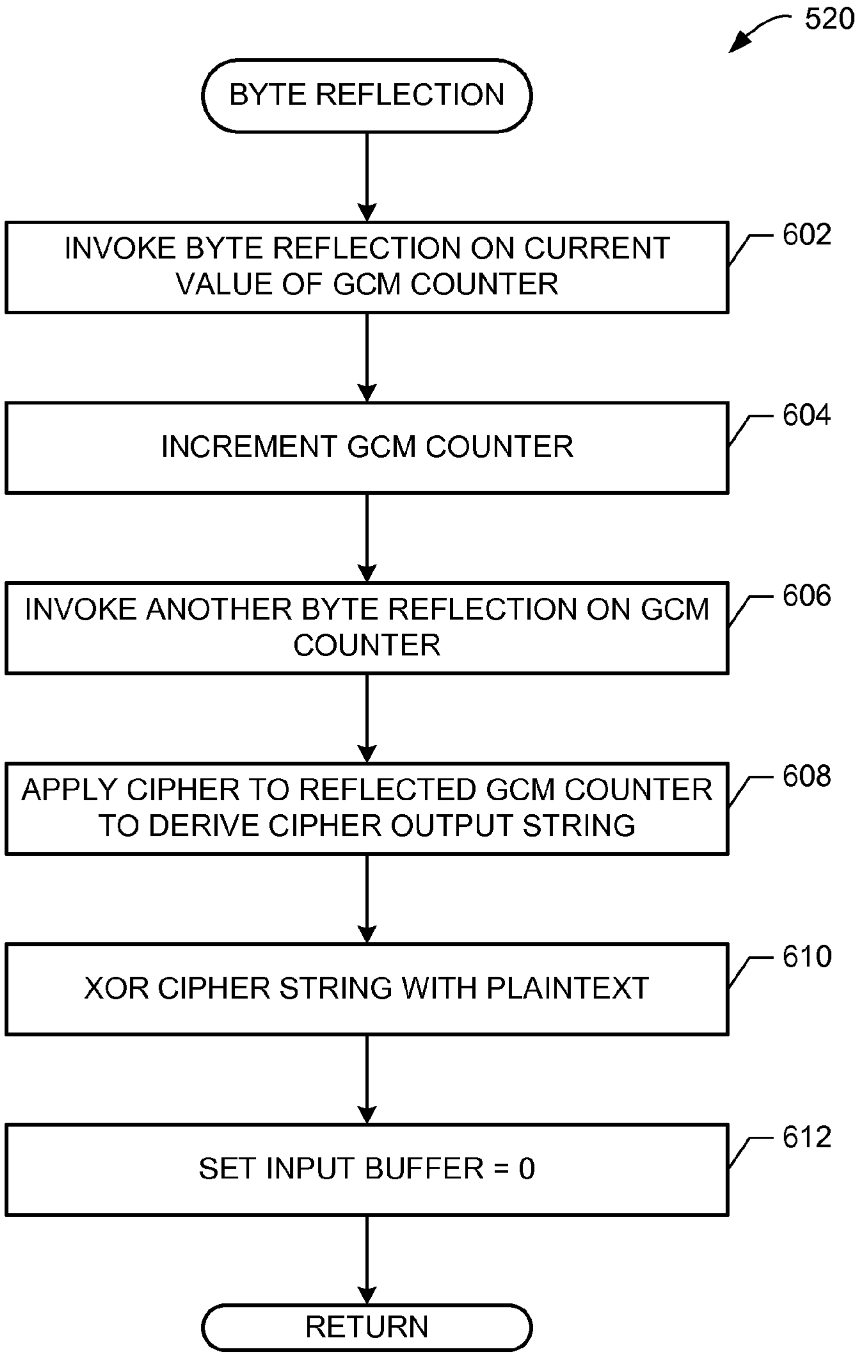
520
BYTE REFLECTION
INVOKE BYTE REFLECTION ON CURRENT VALUE OF GCM COUNTER
602
INCREMENT GCM COUNTER
604
INVOKE ANOTHER BYTE REFLECTION ON GCM COUNTER
606
APPLY CIPHER TO REFLECTED GCM COUNTER TO DERIVE CIPHER OUTPUT STRING
608
XOR CIPHER STRING WITH PLAINTEXT
610
SET INPUT BUFFER = 0
612
RETURN

FIG. 6

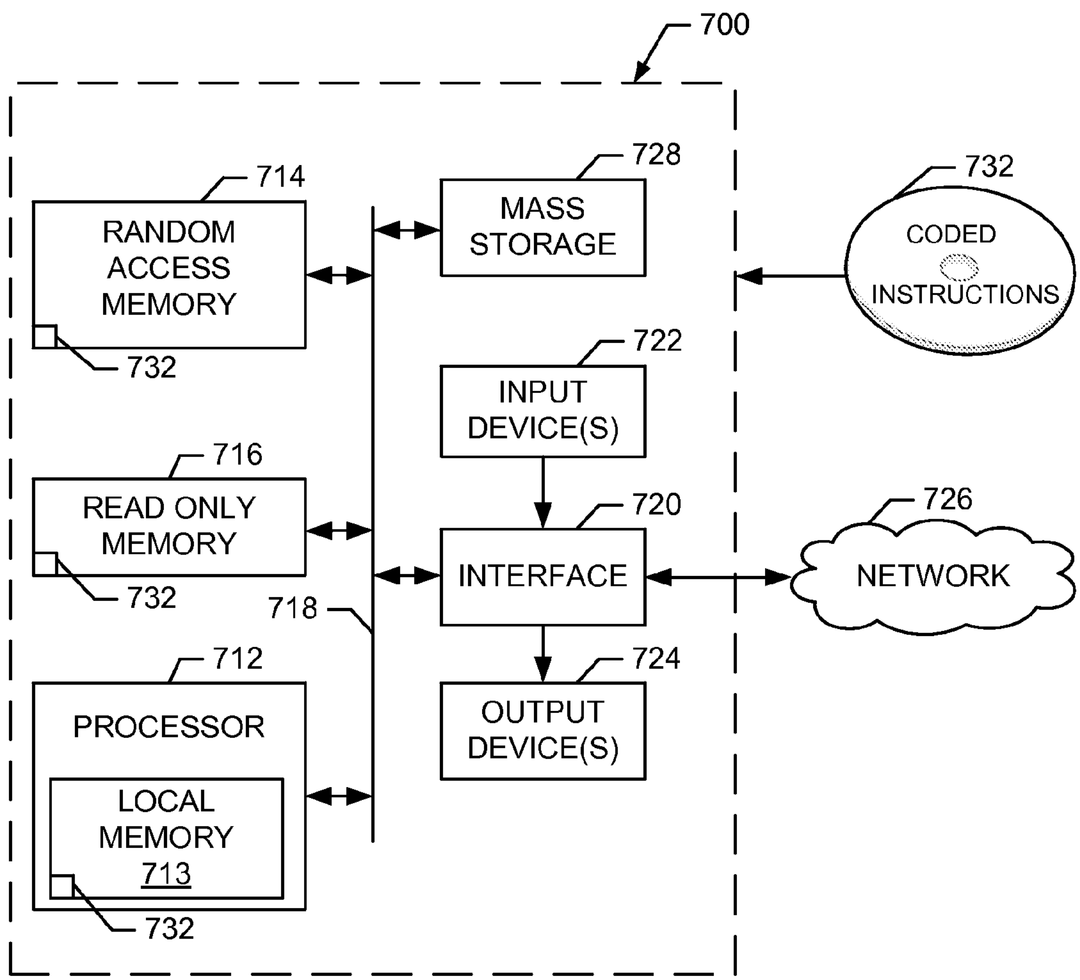
700
728
MASS STORAGE
714
RANDOM ACCESS MEMORY
732
732
CODED INSTRUCTIONS
722
INPUT DEVICE(S)
716
READ ONLY MEMORY
732
720
INTERFACE
726
NETWORK
718
712
PROCESSOR
LOCAL MEMORY
713
732
724
OUTPUT DEVICE(S)

FIG. 7

METHODS, SYSTEMS AND APPARATUS TO REDUCE PROCESSOR DEMANDS DURING ENCRYPTION

FIELD OF THE DISCLOSURE

This disclosure relates generally to encryption, and, more particularly, to methods, systems and apparatus to reduce processor demands during encryption.

BACKGROUND

Computing systems are faced with obligations to provide data security services, such as one or more encryption services and/or authentication services. Encryption services are typically performed by one or more algorithm ciphers, which may employ one or more keys to convert information from plain text into ciphertext. A trusted and widely adopted block-type symmetric-key cipher is the Advanced Encryption Standard (AES) cipher that was adopted by the U.S. Government. The AES cipher may introduce a significant amount of computing system burden when performing its iterative cycles of ciphertext generation. Such computing system burdens may be further exacerbated based on a size of the key.

Computing systems may also employ authentication services together with the encryption and/or decryption services. The Galois Counter Mode (GCM) combines encryption with authentication in a manner that takes advantage of parallel operation(s) of the computing system on which it operates.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is example pseudo code implementing an example cipher algorithm to facilitate byte reflection with an encryption cipher.

FIG. **2** is a schematic illustration of a portion of an example processor platform to reduce processor demands during encryption consistent with the teachings of this disclosure.

FIG. **3** is a schematic illustration of an example GCM engine of FIG. **2**.

FIG. **4** is example pseudo code implementing an example cipher algorithm to reduce processor demands during encryption consistent with the teachings of this disclosure.

FIGS. **5** and **6** are flowcharts representative of example machine readable instructions which may be executed to reduce processor demands during encryption.

FIG. **7** is a schematic illustration of an example processor platform that may execute the instructions of FIGS. **5** and **6** to implement the example systems and apparatus of FIGS. **1-4**.

DETAILED DESCRIPTION

The combination of data security and authentication may be realized on a computing system by way of the Galois Counter Mode (GCM) block cipher mode. Such combinations are particularly important to one or more services used by the computing system, such as Internet Protocol (IP) security applications (IPSec) and applications for secure virtual private network (VPN) connectivity. IPSec secures IP communication by, in part, authenticating and encrypting each IP packet of a communication session.

When performing both cipher operations for data security and authentication operations, the architectural resources of the computing system become burdened when working on blocks of input data. Because the GCM operation causes a relatively high operations-per-cycle retirement rate, and uses most or all available processor registers, parallelized optimizations are pushed to a finite level of availability. In other words, further parallelization may not be possible and/or yield anything other than negligible boosts in GCM performance.

Some services and/or operations performed by the computing system operate with registers weighted in a manner inconsistent with GCM. For example, an example service invoked to be executed by the computing system may establish a most significant bit (MSB) and a least significant bit (LSB) in a manner opposite to that employed by GCM. In such circumstances, byte reflection is performed to switch register weights in a manner that facilitates consistent operation. When applying GCM to applications that require byte reflection, such as IPSec, the data security (cipher) services must also be tailored to work with the byte reflected applications. In other words, the manner in which data is stored in the processor architecture and the manner in which data is stored in the memory does not match in view of MSB and LSB orientation. To bring the orientation in alignment for data security operation(s), such as application of Advanced Encryption Standard (AES) operations, inputs to the algorithm must be byte-reflected. The AES was published by the National Institute of Standards and Technology (NIST) as a standard that employs a secret key system via symmetric block ciphers for encryption and/or decryption operations. Encryption operations (e.g., cipher operations) perform a series of transformations using the secret key (e.g., cipher key) to transform intelligible data (plaintext) into an unintelligible form (e.g., ciphertext). For cipher applications requiring byte reflection, if input bytes were ordered from 15 to 0, then byte reflection re-orients the bytes from 0 to 15.

In the illustrated example of FIG. **1**, pseudo code **100** implementing an AES algorithm is shown for an application associated with IPSec. The example AES algorithm includes a counter "CTR" for its operation, in which the input "CTR" **102** must be byte reflected. AES in GCM works on byte-reflected values, but the counter mode aspect of GCM operates in normal form (e.g., a byte orientation opposite to that employed by AES). As such, the input counter **102** is converted into a normal byte order, incremented, and then byte-reflected back for AES encryption. In other words, prior to using the byte reflected data with a call to the AES cipher **104**, two byte reflection operations occur **106**, **108**. Additional IPSec requirements include a need to add one to the MSB of the initial counter input.

Byte reflection may be accomplished via a "pshufb" instruction, which rearranges bytes. While byte reflection operation efficiency may be improved via a "pshufb" instruction, which can operate using one clock cycle, such "pshufb" instructions are resource intensive and employed during every block iteration of an input buffer. Three separate instructions occur **110** before each call to the AES cipher **104**, and such calls occur within a critical path of processor operation.

FIG. **2** illustrates a portion of an example processor platform **200** that includes processor(s) **202**, memory **204**, a GCM engine **206**, and other hardware **208**, such as a graphics controller **210**, ports **212**, a network interface **214**, and a disk controller **216**, which may be connected to one or more storage devices **218**. The example network interface **214** of FIG. **2** may employ and/or otherwise require IPSec services when establishing VPN connections. While the example GCM engine **206** is illustrated in FIG. **2** as communicatively connected to a bus **220**, the example GCM engine **206** may be, instead, integrated within the processor **202** and/or the memory **204**.

In operation, the example GCM engine **206** monitors the platform **200** for an instance of security services in which one or more byte reflect operations may be needed. In some examples, the network interface **214** invokes a request to the processors **202** for security services. Such a request may include one or more IPSec requests. As described in further detail below, the example GCM engine **206** of FIG. **2** responds to the one or more byte reflect operations in a manner that reduces processing demands on the example processors **202** during security services, such as encryption.

FIG. **3** is a schematic illustration of an example implementation of the example GCM engine **206** of FIG. **2**. In the illustrated example of FIG. **3**, the GCM engine **206** includes a cipher module interface **302**, an authentication module interface **304**, a byte order manager **306**, a byte reflection engine **308**, a carryover detector **310**, and a GCM counter manager **312**. In operation, the example byte order manager **306** monitors the processors **202** for one or more service requests related to an operation that requires byte reflection. In the event one or more security services do not require byte reflection, then the example byte order manager invokes default data security and/or authentication services from one or more ciphers and/or authentication modules. On the other hand, in the event the example byte order manager **306** identifies that one or more security services require byte reflection, then the example cipher module interface **302** and/or the example authentication module interface **304** invoke corresponding ciphers and/or authentication algorithms, respectively. For example, GCM services parallelize AES encryption with the GHASH hash-based authentication component.

FIG. **4** illustrates pseudo code implementing an example AES algorithm **400** to reduce processor demands during encryption. In the illustrated example of FIG. **4**, the byte order manager **306** identifies the MSB of a counter of the GCM (**402**), and sets an input buffer index value "index" to the MSB position (**404**). The example carryover detector **310** determines whether the buffer index will have a carry at its next iteration of the counter block input (**406**). In some examples, the carryover condition is identified by comparing the MSB of the buffer with a maximum block size of the counter. If a carryover will not occur, then the example methods, systems and apparatus disclosed herein to reduce processor demands during encryption allow the AES cipher to operate without employing pshufb instructions (**408**), thereby reducing a corresponding processor **202** load. In some examples, reducing the processor load includes replacing the pshufb instructions with one or more logical shift operations (e.g., left-shift operator(s) "<<", right-shift operator(s) ">>", bitwise operator(s), arithmetic shift(s), logical shift(s), etc.), which requires substantially fewer computational demands of the processor **202**.

If the example carryover detector **310** determines that the GCM input buffer will not invoke a carryover at a next iteration of the counter block input (**406**), then the example GCM counter manager **312** adds a value of 1 to the MSB of the GCM counter "CTR" (**410**). The shifted counter value is applied to the cipher (e.g., AES) by the example cipher module interface **302**. The example cipher module interface **302** uses a key to calculate a cipher output string (**412**). The cipher output string is XORed with plaintext to generate ciphertext (**414**). The example byte order manager **306** increments the input buffer index value (**416**) so that the next block iteration may be tested for the possibility of a carry overflow (**406**).

In the event of a carry overflow (**406**), the example byte order manager **306** invokes traditional techniques to apply the cipher (e.g., AES) for data security (**418**). In particular, byte reflection operations require at least two pshufb operations, as described above in connection with FIG. **1**. At least one benefit of the AES algorithm **400** of FIG. **4** is that the relatively processor intensive pshufb operations only occur one time per block for a given block size. For example, a block size of 256 may employ the AES cipher without pshufb operations for 255 iterations of the block, thereby relieving the example processor platform **200** of a substantial computational burden (e.g., reducing the load from 256 pshfb operations to one).

While an example manner of implementing the example platform **200** and/or the example GCM engine **206** to reduce processor demands during encryption has been illustrated in FIGS. **2-4**, one or more of the elements, processes and/or devices illustrated in FIGS. **2-4** may be combined, divided, re-arranged, omitted, eliminated and/or implemented in any other way. Further, any or all of the example GCM engine **206**, the example cipher module interface **302**, the example authentication module interface **304**, the example byte order manager **306**, the example byte reflection engine **308**, the example carryover detector **310** and/or the example GCM counter manager **312** of FIGS. **2** and **3** may be implemented by hardware, software, firmware and/or any combination of hardware, software and/or firmware. Thus, for example, any of the example GCM engine **206**, the example cipher module interface **302**, the example authentication module interface **304**, the example byte order manager **306**, the example byte reflection engine **308**, the example carryover detector **310** and/or the example GCM counter manager **312** of FIGS. **2** and **3** could be implemented by one or more circuit(s), programmable processor(s), application specific integrated circuit(s) (ASIC(s)), programmable logic device(s) (PLD(s)) and/or field programmable logic device(s) (FPLD(s)), etc. When any of the apparatus or system claims of this patent are read to cover a purely software and/or firmware implementation, at least one of the example GCM engine **206**, the example cipher module interface **302**, the example authentication module interface **304**, the example byte order manager **306**, the example byte reflection engine **308**, the example carryover detector **310** and/or the example GCM counter manager **312** of FIGS. **2** and **3** are hereby expressly defined to include a tangible computer readable storage medium such as a memory, DVD, CD, Blu-ray, etc. storing the software and/or firmware. Further still, the example platform **200** of FIG. **2** and the example GCM engine **206** of FIGS. **2** and **3** may include one or more elements, processes and/or devices in addition to, or instead of, those illustrated in FIGS. **2-4**, and/or may include more than one of any or all of the illustrated elements, processes and devices.

Flowcharts representative of example machine readable instructions for implementing the platform **200** of FIG. **2**, the example GCM engine **206** of FIGS. **2** and **3** and/or the example AES algorithm **400** of FIG. **4** are shown in FIGS. **5** and **6**. In this example, the machine readable instructions comprise a program for execution by a processor such as the processor **712** shown in the example computer **700** discussed below in connection with FIG. **7**. The program may be embodied in software stored on a tangible computer readable storage medium such as a CD-ROM, a floppy disk, a hard drive, a digital versatile disk (DVD), a Blu-ray disk, or a memory associated with the processor **712**, but the entire program and/or parts thereof could alternatively be executed by a device other than the processor **712** and/or embodied in firmware or dedicated hardware. Further, although the example program is described with reference to the flowcharts illustrated in FIGS. **5** and **6**, many other methods of implementing the example platform **200**, the example GCM engine **206** and the example AES algorithm to reduce processor demands during encryption may alternatively be used. For example, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, or combined.

As mentioned above, the example processes of FIGS. **5** and **6** may be implemented using coded instructions (e.g., computer readable instructions) stored on a tangible computer readable storage medium such as a hard disk drive, a flash memory, a read-only memory (ROM), a compact disk (CD), a digital versatile disk (DVD), a cache, a random-access memory (RAM) and/or any other storage device and/or storage disc in which information is stored for any duration (e.g., for extended time periods, permanently, brief instances, for temporarily buffering, and/or for caching of the information). As used herein, the term tangible computer readable storage medium is expressly defined to include any type of computer readable storage device and/or storage disc and to exclude propagating signals. Additionally or alternatively, the example processes of FIGS. **5** and **6** may be implemented using coded instructions (e.g., computer readable instructions) stored on a non-transitory computer readable storage medium such as a hard disk drive, a flash memory, a read-only memory, a compact disk, a digital versatile disk, a cache, a random-access memory and/or any other storage media in which information is stored for any duration (e.g., for extended time periods, permanently, brief instances, for temporarily buffering, and/or for caching of the information). As used herein, the term non-transitory computer readable medium is expressly defined to include any type of computer readable storage device and/or storage disc and to exclude propagating signals. As used herein, when the phrase "at least" is used as the transition term in a preamble of a claim, it is open-ended in the same manner as the term "comprising" is open ended. Thus, a claim using "at least" as the transition term in its preamble may include elements in addition to those expressly recited in the claim.

The program **500** of FIG. **5** begins at block **502** where the example byte order manager **306** determines whether one or more security operations associated with byte reflection are to be processed by the example processor **202**. If not, then the example byte order manager **306** invokes default data security and/or authentication services (block **504**). However, in the event that the byte order manager **306** determines that operations requiring byte reflection have been invoked and/or are otherwise to be executed by the processor **202** (block **502**), then the example cipher module interface **302** and the example authentication module interface **304** are invoked to begin GCM operations (block **506**).

The example byte order manager **306** identifies the MSB of a counter of the GCM engine **206** and sets a buffer index value to the MSB position (block **508**). If the example carryover detector **310** determines that the buffer index value will not experience a carry at its next iteration (block **510**), then the example GCM counter manager **312** adds 1 to the MSB of the GCM counter (block **512**). The example cipher module interface **302** applies the cipher to the incremented (e.g., incremented by a byte shift operation) GCM counter to determine an output string (block **514**), and XORs the cipher string with plain text to generate ciphertext (block **516**). The example byte order manager **306** increments the buffer index value by 1 (block **518**) and control returns to block **510** to determine whether a carryover will occur.

In the event a carryover will occur at the next iteration (block **510**), the example byte reflection engine initializes byte reflection operations (block **520**). Example byte reflection operations are illustrated in FIG. **6**. In the illustrated example of FIG. **6**, the byte reflection engine **308** invokes a byte reflection operation by way of a pshufb operation on the current value of the GCM counter (block **602**). The example GCM counter manager **312** increments the GCM counter (block **604**) and the example byte reflection engine **308** invokes another pshufb operation to byte reflect the GCM counter (block **606**). The cipher (e.g., AES) is applied to the reflected GCM counter by the example cipher module interface **302** to derive a cipher output string (block **608**), and the cipher string is XORed with plaintext (block **610**). Because byte reflection via pshufb operations/instructions only occurs during instances of block carryover, the example byte order manager **306** resets the input buffer value to zero (block **612**), and control returns to block **510** of FIG. **5** to determine whether the next iteration of another input buffer value (e.g., from a requesting IPsec operation) will cause a carry.

FIG. **7** is a block diagram of an example processor platform **700** capable of executing the instructions of FIGS. **5** and **6** to implement the platform **200** of FIG. **2**, the GCM engine **206** of FIGS. **2** and **3**, and/or the program **400** of FIG. **4**. The processor platform **700** can be, for example, a server, a personal computer, an Internet appliance, a mobile device, or any other type of computing device.

The system **700** of the instant example includes a processor **712**. For example, the processor **712** can be implemented by one or more microprocessors or controllers from any desired family or manufacturer.

The processor **712** includes a local memory **713** and is in communication with a main memory including a volatile memory **714** and a non-volatile memory **716** via a bus **718**. The volatile memory **714** may be implemented by Synchronous Dynamic Random Access Memory (SDRAM), Dynamic Random Access Memory (DRAM), RAMBUS Dynamic Random Access Memory (RDRAM) and/or any other type of random access memory device. The non-volatile memory **716** may be implemented by flash memory and/or any other desired type of memory device. Access to the main memory **714**, **716** is controlled by a memory controller.

The processor platform **700** also includes an interface circuit **720**. The interface circuit **720** may be implemented by any type of interface standard, such as an Ethernet interface, a universal serial bus (USB), and/or a PCI express interface.

One or more input devices **722** are connected to the interface circuit **720**. The input device(s) **722** permit a user to enter data and commands into the processor **712**. The input device(s) can be implemented by, for example, a keyboard, a mouse, a touchscreen, a track-pad, a trackball, isopoint and/or a voice recognition system.

One or more output devices **724** are also connected to the interface circuit **720**. The output devices **724** can be implemented, for example, by display devices (e.g., a liquid crystal display, a cathode ray tube display (CRT), a printer and/or speakers). The interface circuit **720**, thus, typically includes a graphics driver card.

The interface circuit **720** also includes a communication device such as a modem or network interface card to facilitate exchange of data with external computers via a network **726** (e.g., an Ethernet connection, a digital subscriber line (DSL), a telephone line, coaxial cable, a cellular telephone system, etc.).

The processor platform **700** also includes one or more mass storage devices **728** for storing software and data. Examples of such mass storage devices **728** include floppy disk drives, hard drive disks, compact disk drives and digital versatile disk (DVD) drives.

The coded instructions **732** of FIGS. **5** and **6** may be stored in the mass storage device **728**, in the volatile memory **714**, in the non-volatile memory **716**, and/or on a removable storage medium such as a CD or DVD. Methods, apparatus, systems and articles of manufacture are disclosed to reduce processor demands during encryption. Some disclosed example methods include detecting a request for the processor to execute an encryption cipher, determining whether the encryption cipher is associated with a byte reflection operation, preventing the byte reflection operation when a buffer associated with the encryption cipher will not cause a carryover condition, and incrementing the buffer via a shift operation before executing the encryption cipher. Other disclosed example methods include employing an Advanced Encryption Standard (AES) cipher as the encryption cipher. Still other disclosed example methods include byte reflection operations based on a request for Internet Protocol Security (IPSec) communication. Some disclosed example methods include associating the buffer with a Galois Counter Mode (GCM) block cipher mode, determining a most significant bit associated with the buffer, and identifying the carryover condition by comparing the most significant bit of the buffer with a maximum block size. Other disclosed example methods include replacing a pshufb operation with a logical shift operation, and applying a pshufb operation to byte reflect the buffer when the carryover condition is true.

Example apparatus to reduce processor demands during encryption include a cipher module interface to detect a request for the processor to execute an encryption cipher, a byte order manager to determine whether the encryption cipher is associated with a byte reflection operation, a carryover detector to prevent the byte reflection operation when a buffer associated with the encryption cipher will not cause a carryover condition, and a counter manager to increment the buffer via a shift operation before executing the encryption cipher. Other example disclosed apparatus include the cipher module interface to employ an Advanced Encryption Standard (AES) cipher, and the cipher module interface to identify a request for Internet Protocol Security (IPSec) communication. Some example disclosed apparatus associate the buffer with a Galois Counter Mode (GCM) block cipher mode, in which the byte order manager is to determine a most significant bit associated with the buffer. Still other example disclosed apparatus include the carryover detector to identify the carryover condition by comparing the most significant bit of the buffer with a maximum block size. Other example disclosed apparatus include the counter manager to replace a pshufb operation with a logical shift operation in response to preventing the byte reflection operation and/or the counter manager is to invoke a pshufb operation to byte reflect the buffer when the carryover condition is true.

Some disclosed example machine readable storage mediums comprising instructions that, when executed, cause a machine to detect a request for the processor to execute an encryption cipher, determine whether the encryption cipher is associated with a byte reflection operation, prevent the byte reflection operation when a buffer associated with the encryption cipher will not cause a carryover condition, and increment the buffer via a shift operation before executing the encryption cipher. Some example machine readable storage mediums include initiating an Advanced Encryption Standard (AES) cipher. Other example machine readable storage mediums include initiating a Galois Counter Mode (GCM) block cipher mode, and determining a most significant bit associated with the buffer associated with the GCM block cipher mode, and/or identifying the carryover condition by comparing the most significant bit of the buffer with a maximum block size. Some example machine readable storage mediums include replacing a pshufb operation with a logical shift operation, or applying a pshufb operation to byte reflect the buffer when the carryover condition is true.

Although certain example methods, apparatus and articles of manufacture have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus and articles of manufacture fairly falling within the scope of the claims of this patent.

What is claimed is:

1. A method to reduce a load on a processor, comprising:
- detecting a request for the processor to execute an encryption cipher;
- determining whether the encryption cipher is associated with a byte reflection operation;
- preventing the byte reflection operation when a buffer associated with the encryption cipher will not cause a carryover condition; and
- incrementing the buffer via a shift operation before executing the encryption cipher.

2. A method as defined in claim **1**, wherein the encryption cipher includes an Advanced Encryption Standard (AES) cipher.

3. A method as defined in claim **1**, wherein the byte reflection operation is based on a request for Internet Protocol Security (IPSec) communication.

4. A method as defined in claim **1**, wherein the buffer is associated with a Galois Counter Mode (GCM) block cipher mode.

5. A method as defined in claim **4**, further including determining a most significant bit associated with the buffer.

6. A method as defined in claim **5**, wherein the carryover condition is identified by comparing the most significant bit of the buffer with a maximum block size.

7. A method as defined in claim **1**, wherein preventing the byte reflection operation includes replacing a pshufb operation with a logical shift operation.

8. A method as defined in claim **1**, wherein the byte reflection operation includes a pshufb operation.

9. A method as defined in claim **1**, further including applying a pshufb operation to byte reflect the buffer when the carryover condition occurs.

10. A processor, comprising:
- a cipher module interface to detect a request for the processor to execute an encryption cipher;
- a byte order manager to determine whether the encryption cipher is associated with a byte reflection operation;
- a buffer associated with the encryption cipher;
- a carryover detector to prevent the byte reflection operation when the buffer will not exhibit a carryover condition; and
- a counter manager to increment the buffer via a shift operation before the encryption cipher is executed.

11. A processor as defined in claim **10**, wherein the cipher module interface is to employ an Advanced Encryption Standard (AES) cipher.

12. A processor as defined in claim **10**, wherein the cipher module interface is to identify a request for Internet Protocol Security (IPSec) communication.

13. A processor as defined in claim **10**, wherein the buffer is associated with a Galois Counter Mode (GCM) block cipher mode.

14. A processor as defined in claim **13**, wherein the byte order manager is to determine a most significant bit associated with the buffer.

15. A processor as defined in claim **14**, wherein the carryover detector is to identify the carryover condition by comparing the most significant bit of the buffer with a maximum block size.

16. A processor as defined in claim **10**, wherein the counter manager is to replace a pshufb operation with a logical shift operation in response to preventing the byte reflection operation.

17. A processor as defined in claim **10**, wherein the byte reflection operation includes a pshufb operation.

18. A processor as defined in claim **10**, wherein the counter manager is to invoke a pshufb operation to byte reflect the buffer when the carryover condition occurs.

19. A tangible computer readable storage medium comprising instructions that, when executed, cause a processor to, at least:

in response to a request for the processor to execute an encryption cipher, determine whether the encryption cipher is associated with a byte reflection operation;

prevent the byte reflection operation when a buffer associated with the encryption cipher will not exhibit a carryover condition; and

increment the buffer via a shift operation before executing the encryption cipher.

20. A tangible computer readable storage medium as defined in claim **19**, wherein the instructions, when executed, cause the processor to initiate an Advanced Encryption Standard (AES) cipher.

21. A tangible computer readable storage medium as defined in claim **19**, wherein the instructions, when executed, cause the processor to initiate a Galois Counter Mode (GCM) block cipher mode.

22. A tangible computer readable storage medium as defined in claim **21**, wherein the instructions, when executed, cause the processor to determine a most significant bit associated with the buffer associated with the GCM block cipher mode.

23. A tangible computer readable storage medium as defined in claim **22**, wherein the instructions, when executed, cause the processor to identify the carryover condition by comparing the most significant bit of the buffer with a maximum block size.

24. A tangible computer readable storage medium as defined in claim **19**, wherein the instructions, when executed, cause the processor to replace a pshufb operation with a logical shift operation.

25. A tangible computer readable storage medium as defined in claim **19**, wherein the instructions, when executed, cause the processor to apply a pshufb operation to byte reflect the buffer when the carryover condition occurs.

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